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so far as we understand the movement, pragmatism does not credit science with the ability to build up a philosophy. To pragmatists the will to believe and the personal equation are more important than the assured results of scientific inquiry while science is criticised for the instability of its doctrines.

We do not believe that C. S. Peirce and Prof. William James can be lumped together as if their pragmatism were one and the same. Each of them has his own preferences but both are very different. Mr. Peirce is strong in logic and truly scientific in his work, while William James is very original and ingenious. But if pragmatism, as commonly understood, were truly nothing but another name for "scientific method," it would not have anything new to offer, and there would be no need of starting life over again; it would have been sufficient to continue the work of science and apply its methods more and more thoroughly in all fields, especially in the department of philosophy.

#### ON POINCARÉ'S "MATHEMATICAL CREATION."<sup>1</sup>

M. Poincaré's essay on mathematical invention which appeared in the July *Monist*, is of supreme interest for the psychologist. It offers a valuable contribution to the psychology of genius, at the same time relegating "unconscious cerebration," the importance of which has been somewhat exaggerated, to the place it ought to occupy.

Why are so few men capable of mathematical creation or even of comprehending mathematics? M. Poincaré, I believe, gives the best reason when he attributes this impotence not only to an insufficient strength of memory and attention, but even and especially to the absence of a special intuition, of a proper feeling for mathematical questions.

A mathematical demonstration in fact, as he rightly says, is not a simple juxtaposition of syllogisms, but a succession of syllogisms placed "in a certain order"—an order which the true mathematician feels directly so that he perceives as "a whole" the course of reasoning which supports it.

In my opinion a secondary difficulty upon which Poincaré has nothing to say and of which he has perhaps failed to take note, lies in the use of symbols. This difficulty (and we may note in passing that scientific symbols are usually repugnant to artists, especially

<sup>1</sup> Translated from the French by Lydia G. Robinson.

to painters) generally appears whenever we depart from the concrete, or rather from a presentation which is familiar to us, to pass to one which is less, or not at all, familiar. Thus certain people have trouble in relating the true geography of a country to its representation on a map. Such again in other respects is the case of the musician who does not compose without resorting to his instrument, even when the written notes arouse the sounds in his ear.<sup>2</sup>

It is not by accident that I refer to this instance. Mathematics and music are closely comparable, however different the two studies may be in other respects. Both require aptitudes above all which are most definite and most easily recognizable. And let no one think that the talent of the musician rests only in the quality of his hear! The musical faculty, no less than the mathematical, requires a special intuition. An intrinsic logic regulates invention in music, and consequently its comprehension, as well as in the most abstruse calculus. Like the mathematician the composer<sup>3</sup> chooses from among themes offered to him those that are productive, that is to say susceptible of development. There are ideas or themes which lead to nothing; and the developments of a fertile idea not only obey known rules, but there must be a particular sense, a direct spontaneous understanding of the logic according to which they are arranged.

Let us now come to the part played in invention by the unconscious or the subconscious.

The period of unconsciousness does not indicate simply a rest, a recuperation of cerebral energy. It performs work; but what work? That is the question. It is not purely automatic since there is a choice. Is it then the unconscious which makes the choice and which thus becomes more clear sighted than the conscious? Poincaré refuses to believe so. The performance of actual work, he says, must precede the mysterious operation of the subconscious, and this very operation can be completed only in a fully conscious state. How then shall we explain the choice? According to him the results produced by the subconscious or subliminal will be those which interest the sensibility, like the esthetic sense of the mathematician; only those proposed combinations which satisfy his esthetic sense (and this indeed is very important in mathematics<sup>4</sup>) will pass

<sup>2</sup> See my "Observation sur une musicienne" in *Revue philosophique*, Sept. 1903, and *Art et psychologie individuelle* (Paris, F. Alcan, 1906).

<sup>3</sup> I mean especially the composer of symphonies. Dramatic music is "modulated" not "developed."

<sup>4</sup> In chess a bad play gives an unpleasant appearance to the chess board,

through the sieve of unconsciousness. But there is always a succession of voluntary efforts which has put the whole machine into motion and offers favorable combinations.

The eminent geometrician is entirely right, and I can not protest too strongly against the tendency of certain psychologists to exaggerate the rôle of the unconscious after it had been too much neglected. Distrust of our reason must not lead us to yield everything to instinct; nor the scorn of clear thought, to imagine any sort of obscure intelligence.

It is now many years since I myself pointed out "the positive orientation which serves as a good preparation for our system of images,"<sup>5</sup> and noted that this orientation presupposed a "choice."<sup>6</sup> I was speaking of the work of the artist and poet, but are there not the closest relations between our most widely diversified modes of creation?

Have we not all observed also what happens when we have left a task in what I shall call a state of confusion (*embrouillement*)? When we resume it we no doubt gain by the comparative rest accorded our nervous cells, but only the salient ideas, the principal points of view have survived and have taken their rank in the confused mass of our thoughts. The task already begun has been continued in our mind; a sort of purification has taken place and one last effort is enough to bring it to the point. So, borrowing M. Poincaré's comparison, the gaseous atoms put in motion by preliminary effort continue their dance after our will no longer has control, but in the direction in which it has impelled them.

If we mean that work is accomplished without us, at least it has always been prepared by us. There is a clear state of consciousness in the finishing as well as at the start.

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#### FOUR-FOLD MAGICS.

Having read Professor Kingery's interesting article in the April *Monist*, entitled "Magic in the Fourth Dimension," I wish but in a case of this kind visual attractiveness is affected, if I may say so, by intellectual attractiveness.

<sup>5</sup> *Memoire et imagination*, p. 134.

<sup>6</sup> *Art et psychol. indiv.*, p. 122.